Basis for Joint Cannery Outfall Mixing Zones

This document is intended as a preliminary review draft. The purpose of the descriptions below is to frame the approach and justification for definition of mixing zones for the canneries outfall in Pago Pago Harbor.

1992 Permits

When the individual cannery discharges in the Inner Harbor were moved to a new Joint Cannery Outfall (JCO) in the Outer Harbor, at about the same time high strength waste segregation was initiated, new NPDES permits for each cannery were issued (the 1992 Permits). These permits, with an effective date of 27 October 1992 included effluent limitations as shown in Table 1. The initial permits included mixing zones for nutrients and an effluent limitation for total ammonia was also included, which implied a mixing zone for ammonia. The mixing zones on which this permit was based were:

- A nutrient mixing zone for total nitrogen (TN) and total phosphorous (TP) based on initial and farfield dilutions. The farfield model was developed during the feasibility studies for the outfall relocation and is documented in the study report.[1] The results of that study were refined and summarized in a subsequent Technical Memorandum supporting the definition of the mixing zone.[2] The nutrient mixing zone was established to be a region 1300 feet in radius centered on the diffuser, with the condition that the boundary of the nutrient mixing zone was not to extend shoreward of the 30 foot contour.

- A mixing zone for total ammonia was used to provide an ammonia effluent limitation[3] and was based on the initial dilution calculated for the selected diffuser configuration. The initial dilution under critical conditions was calculated to be 337:1 for the total flow from both canneries listed in the 1992 Permits.

Receiving water quality monitoring done initially by ASEPA, and subsequently by CH2M HILL, indicated that water quality standards for these parameters were consistently met. In addition CH2M HILL conducted two dye studies and a farfield model validation study that confirmed the model predictions for both the nearfield (initial dilution) and farfield (transport) models.

The 1992 Permits included five metals with effluent "monitoring only" limitations, as well as a requirement for periodic effluent priority pollutant scans. Based on the data collected over the permit period it was determined that both copper and zinc would also require mixing zones. These parameters were included in the renewal permit with an effective date of January 23, 2001 (the 2001 Permits). The effluent limitations are shown in Table 1.

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[1] CH2M HILL , 1991a. Engineering and Environmental Feasibility Evaluation of Waste Disposal Alternatives. Prepared for StarKist Samoa, Inc. March 1991.

[2] CH2M HILL , 1991b. Site-specific Zone of Mixing Determination for the Joint Cannery Outfall Project: Pago Pago Harbor, American Samoa. Prepared for ASEQC, ASEPA, USEPA, StarKist Samoa, and Van Camp Seafood. 26 August 1991.

[3] The 1991 mixing zone application did not include ammonia. Total ammonia was included as an effluent limitation by EPA, and presumably based on the assimilative capacity and the initial dilutions provide in CH2M HILL 1991a and 1991b.

2001 Permits

Other than the inclusion of mixing zones for copper and zinc the only change in effluent limitations was an increased flow limitation for COS Samoa Packing (from 0.72 to 1.40 mgd) and some adjustments for Oil & Grease and TSS limitations. There was no increase in the loading for TN or TP. The mixing zones were revaluated for existing parameters. The 1991 Technical Memorandum included analysis that indicated that there was excess capacity for TN and TP and the model results indicated compliance within the existing mixing zone, which allowed for the flow increase. The effect on initial dilution was minimal and the results presented in the 1991 Technical Memorandum indicated that for a change in total flow from both canneries from 3.62 mgd to 4.3 mgd the initial dilution under critical conditions will change from 337:1 to 313:1.

The mixing zones on which the 2001 Permit effluent limitations were based included:

- The nutrient mixing zone and concomitant effluent limitations for TN and TP were unchanged and based on the same information and conditions as in the earlier 1992 Permits. The small decrease in initial dilution was more than compensated for because of excess capacity in the mixing zone (the mixing zone was initially sized to account for increased production and nutrient loading).

- The total ammonia mixing zone and effluent limitations was unchanged and based on the same information and conditions as in the earlier 1992 Permits. There is excess sufficient assimilative capacity even with the small decreases in critical initial dilution.

- The copper and zinc mixing zones were based on the same critical initial conditions developed for the 1992 Permits, with the indicated decrease in initial dilution, and the available receiving water data for metals, collected by CH2M HILL during four monitoring episodes in 1996 and 1997.[4]

Receiving water quality monitoring done semiannually[5] beginning in 2001 have consistently demonstrated compliance with ASWQS for all mixing zone parameters including copper and zinc. A study was conducted to determine the source of zinc and copper and it was determined that these metals occur in the effluent primarily because of leaching from storage, handling, and processing equipment. There is no identifiable approach for source control for these parameters.

The 2001 Permits included a requirement for priority pollutant scans. The results of these analyses indicated that mercury would require a mixing zone. The canneries began testing for mercury in the effluent concurrently with the required bioassay tests and have completed four tests.[6] The available effluent mercury data are provided in Table 2.

Proposed Renewal Mixing Zones

For the current permit renewal the canneries are not requesting any changes in effluent limitations, with the obvious and appropriate request for a mixing zone for mercury. There have been no changes in diffuser configuration and the original initial dilution and farfiled

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[4] The four monitoring reports were submitted to EPA and ASEPA.

[5] Ten monitoring reports from 2001 through 2005 have been submitted to EPA and ASEPA, the 2006 reports are in preparation.

[6] The results of the first three tests have been submitted to EPA and ASEPA. The fourth test report (February 2007) is in preparation.

transport simulations were based on critical conditions.   Therefore, no additional modeling is required.

The canneries request mixing zones for:

- TN and TP with no changes from the original definition

- Total ammonia with no changes from the original definition

- Copper and Zinc with no changes from the original definition

- Mercury as described below.

The requested limitations consistent with the mixing zones are shown in Table 1, where they are compared to the 1991 Permit and 2001 Permit effluent limitations.

New Mixing Zone for Mercury

The basis for the mixing zone for mercury is described in Table 2 and the following points concerning the calculations provide a more detailed explanation:

- The first section of Table 2 is a tabulation of the recent data on mercury concentrations in the effluent. The values for COS Samoa Packing (COS) and StarKist Samoa (SKS) are listed as well as a flow weighted average for each sampling period based on the maximum permitted flows for each cannery.

- The second section is a calculation of the reasonable potential maximum effluent concentration based on a 99 percent probability that the concentration will not exceed this value.[7] It is noted that the individual cannery effluent concentrations and the flow weighted averages are essentially identical with respect to the reasonable potential effluent concentration for mercury.

- The EPA Technical Support Document referenced above indicates that the calculation of reasonable potential may not be reliable for less than 10 samples and suggests using a CV of 0.6 for small data sets (until sufficient data are available). This procedure was used in Table 2, but the calculated CV is also shown and is very close to 0.6 for all cases.

- The third section of the table illustrates the dilution required to meet the ASWQS for mercury for the reasonable potential effluent concentration and assuming the highest receiving water value observed at stations in the vicinity of the discharge. This section also shows the assimilative capacity (maximum allowable effluent concentration) of the receiving water, for the highest observed mercury concentration in the vicinity of the discharge based on the critical initial dilution for the maximum permitted flows.

The reasonable potential was nearly identical for the individual cannery effluents and the flow-weighted average. It is proposed that an effluent limitation of 1.1 µg/l be applied for both canneries to avoid potential violations while additional effluent data are collected. The dilution required to meet water quality standards is approximately 40:1, which is only a small fraction of the initial dilution under critical conditions. This also represents only a small fraction (about 0.125) of the assimilate capacity based on initial dilution, receiving water concretions, and the ASWQS criterion for mercury.

Table 1. Effluent Limitations						
Parameter	1992 Permits		2001 Permits		Proposed	
	COS	SKS	COS	SKS	COS	SKS
Flow (mgd)	0.72	2.9	1.4	2.9	1.4	2.9
BOD_5 - Average	MO	MO	MO	MO	MO	MO
BOD_5 - Maximum	MO	MO	MO	MO	MO	MO
TSS (lbs/day) - Average	2304	2563	2376	2996	2376	2996
TSS (lbs/day) - Maximum	5312	6673	5976	7536	5976	7536
Oil & Grease (lbs/day) - Average.	538	675	605	763	605	763
Oil & Grease (lbs/day) - Maximum	1344	1688	1512	1907	1512	1907
Total Phosphorus (lbs/day) - Average	208	192	208	192	208	192
Total Phosphorus (lbs/day) - Maximum	271	309	271	309	271	309
Total Nitrogen (lbs/day) - Average	800	1200	800	1200	800	1200
Total Nitrogen (lbs/day) - Maximum	1935	2100	1935	2100	1935	2100
Acute Toxicity (LC50) - Maximum	MO	MO	MO	MO	MO	MO
Total Ammonia (mg/l) - Maximum	133	133	133	133	133	133
Temperature (°F) - Average	90	90	90	90	90	90
Temperature (°F) - Maximum	95	95	95	95	95	95
Total Cadmium (µg/l)	MO	MO	--	--	--	--
Total Chromium (µg/l)	MO	MO	--	--	--	--
Total Lead (µg/l)	MO	MO	--	--	--	--
Total Mercury (µg/l) - Maximum	MO	MO	--	--	1.1	1.1
Total Copper (µg/l) – Average	--	--	66	66	--	--
Total Copper (µg/l) – Maximum	--	--	108	108	108	108
Total Zinc (µg/l) - Average	MO	MO	1545	1545	--	--
Total Zinc (µg/l) - Maximum	--	--	1770	1770	1770	1770
pH - Minimum	6.5	6.5	6.5	6.5	6.5	6.5
pH - Maximum	8.6	8.6	8.6	8.6	8.6	8.6
		Shaded cells represent effluent limitations based on a mixing zone.				

[7] The reasonable potential effluent concentration is calculated using the method from EPA's Technical Support Document for Water Quality-based Toxics Control

Table 2. Mixing Zone Calculations for Mercury (μg/l)			
	COS	SKS	Flow Weighted
Available Effluent Data for Mercury			
Effluent Concentration: September 2004[1]	0.23	0.27	0.257
Effluent Concentration: August 2005[2]	0.202	0.117	0.145
Effluent Concentration: March 2006[2]	0.113	0.126	0.122
Effluent Concentration: November 2006[2]	0.093	0.113	0.106
Effluent Concentration: February 2007[2]	0.072	0.064	0.066
Reasonable Potential Calculations			
Number of Samples	5.0	5.0	5.0
Maximum	0.230	0.270	0.257
Average	0.142	0.138	0.139
Minimum	0.072	0.064	0.066
Standard Deviation	0.070	0.078	0.072
Coefficient of Variation (Calculated)	0.49	0.56	0.52
Coefficient of Variation (Recommended)[3]	0.60	0.60	0.60
Confidence Level	0.99	0.99	0.99
Probability Level (Pl)	0.99	0.99	0.99
Probability of Maximum (Pn)	0.40	0.40	0.40
Z of Pn	-0.26	-0.26	-0.26
Z of Pl	2.33	2.33	2.33
Standard Deviation (log normal)	0.555	0.555	0.555
Reasonable Potential Multiplier	4.19	4.19	4.19
Reasonable Potential	0.96	1.13	1.08
Required Dilution and Assimilative Capacity Calculations			
Receiving Water Maximum	0.0232	0.0232	0.0232
ASWQS	0.05	0.05	0.05
Dilution Required to meet ASWQS	35	41	39
Maximum Allowable Effluent Concentration	8.4		
[1] From the priority pollutant scan composite sample. [2] Average values of analyses of eight samples collected over a 24-hour period. [3] A CV of 0.6 was used in the calculations			